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PATENT**Remarks**

The Office Action mailed January 14, 2003 has been carefully reviewed and the following remarks are made in consequence thereof. Submitted herewith is a Submission of Marked Up Paragraph. No new matter has been added.

Claims 1-28 are now pending in this application. Claims 1-7, 9, 11-13, 15-21, 23, and 25-27 stand rejected. Claims 8, 10, 14, 22, 24, and 28 are objected to.

The provisional rejection of Claim 1 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 1 of co-pending U.S. Patent Application No. 09/429,867 is respectfully traversed. Claim 1 has not issued in a U.S. Patent. For at least the reasons given above, Applicant respectfully requests that the provisional double patenting rejection of Claim 1 be withdrawn.

The rejection of Claims 1-5, 9, 11, 15-19, 23, and 25 under 35 U.S.C. § 102(e) as being anticipated by Taguchi et al. (U.S. Patent 5,974,108) is respectfully traversed.

Taguchi et al. describe an X-ray CT scanning apparatus having an X-ray source for irradiating a beam of X-ray to an object to be examined, a detecting means provided with at least two rows of detector elements for detecting the X-ray beam to have a real data, and a couch traveling means for traveling in an axial direction of the body of the object a couch on which the object is placed, and characterized by: irradiating the X-ray beam from the X-ray source which is being rotated and simultaneously, traveling the couch with the couch traveling means to scan the object in a helical direction, and selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means and producing a desired data at the target slicing location by interpolation between the two selected data (see column 4, line 61-column 5, line 9). An image reconstructor (31) accesses an

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interpolator (29) for having imaginary scanned raw data at corresponding slicing locations (see column 25, lines 1-3). In response, a filter processor (29D) of the interpolator reads out one or more of the imaginary scanned raw data at the corresponding slicing location, subjects the data to its filtering action to have a requested data at the target slicing location, and delivers the requested data to an image reconstructor (31) (see column 25, lines 3-9). Upon receiving the requested data at the target slicing location, the image reconstructor processes it by a common fan-beam reconstruction thus reproducing a desired image (see column 25, lines 8-12).

Claim 1 recites a method for imaging an object with a computed tomographic (CT) imaging system, including the steps of "helically scanning the object with a multi-slice CT imaging system to acquire attenuation measurements of the object, the measurements including more than two conjugate samples; estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object".

Taguchi et al. does not describe or suggest a method as recited in Claim 1. Specifically, Taguchi et al. does not describe or suggest a method including the steps of helically scanning the object with a multi-slice CT imaging system to acquire attenuation measurements of the object, the measurements including more than two conjugate samples, estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples, and filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object. Moreover, Taguchi et al. does not describe or suggest a method including the steps of "estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object". Rather, Taguchi et al.

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describe selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means, producing desired data at the target slicing location by interpolation between the two selected data, and processing the requested data by a common fan-beam reconstruction. For the reasons set forth above, Claim 1 is submitted to be patentable over Taguchi et al.

Claims 2-5, 9, and 11 depend from independent Claim 1. When the recitations of 2-5, 9, and 11 are considered in combination with the recitations of Claim 1, Applicant submits that dependent Claims 2-5, 9, and 11 likewise are patentable over Taguchi et al.

Claim 15 recites a computed tomographic (CT) imaging system for imaging an object, the system including a radiation source and a multi-slice detector configured to acquire attenuation measurements of an object between the radiation source and the multi-slice detector, the system configured to "helical scan the object to acquire attenuation measurements of the object, said measurements including more than two conjugate samples; estimate a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object".

Taguchi et al. does not describe or suggest a CT imaging system as recited in Claim 15. Specifically, Taguchi et al. does not describe or suggest a CT imaging system configured to helical scan the object to acquire attenuation measurements of the object, the measurements including more than two conjugate samples, estimate a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples, and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object. Moreover, Taguchi et al. does not describe or suggest a CT imaging system configured to "estimate a projection at a plane of reconstruction of the object using the attenuation

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measurements of the object, including the more than two conjugate samples; and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object". Rather, Taguchi et al. describe selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means, producing desired data at the target slicing location by interpolation between the two selected data, and processing the requested data by a common fan-beam reconstruction.

Claims 16-19, 23, and 25 depend from independent Claim 15. When the recitations of Claims 16-19, 23, and 25 are considered in combination with the recitations of Claim 15, Applicant submits that dependent Claims 16-19, 23, and 25 likewise are patentable over Taguchi et al.

For the reasons set forth above, Applicant respectfully requests that the Section 102 rejection of Claims 1-5, 9, 11, 15-19, 23, and 25 be withdrawn.

The rejection of Claims 6-7, 12-13, 20-21, and 26-27 under 35 U.S.C. § 103(a) as being unpatentable over Taguchi et al. in view of Berlad (U.S. Patent 5,513,120) is respectfully traversed.

Taguchi et al. is described above. Berlad describes providing an interpolated image where the texture of the image does not vary as a function of location (see column 2, lines 16-18). The interpolation is based on a particular type of interpolation known as "four-point interpolation", i.e., interpolation that uses the nearest neighbor grid points and the next nearest neighbor grid points that are in a line with a grid location point requiring interpolated data (see column 2, lines 18-24). The value by interpolation of an image point is obtained in a preferred embodiment using polynomial interpolation where a polynomial of the order N is passed through N+1 image points and is eventually used to compute the interpolated values (see column 4, lines

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1-5). The most general polonomial interpolation is given by the Lagrange polynomial (see column 4, lines 5-6).

Applicant respectfully submits that the Section 103 rejection of the presently pending claims is not a proper rejection. As is well established, obviousness cannot be established by combining the teachings of the cited art to produce the claimed invention, absent some teaching, suggestion, or incentive supporting the combination. Neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest the claimed combination. Furthermore, in contrast to the assertion within the Office Action, Applicant respectfully submits that it would not be obvious to one skilled in the art to combine Taguchi et al. with Berlad because there is no motivation to combine the references suggested in the art.

Furthermore, it is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the cited art so that the claimed invention is rendered obvious. Specifically, one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the art to deprecate the claimed invention. Further, it is impermissible to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art. The present Section 103 rejection is based on a combination of teachings selected from multiple patents in an attempt to arrive at the claimed invention. Specifically, Taguchi et al. is cited for its teaching of selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means, producing desired data at the target slicing location by interpolation between the two selected data, and processing the requested data by a common fan-beam reconstruction, and Berlad is cited for its teaching that the most general polonomial interpolation is given by the Lagrange polynomial. Since there is no teaching nor suggestion in the cited art for the combination, the Section 103 rejection appears to be based on a hindsight reconstruction in which isolated disclosures have been picked and chosen in an attempt to

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deprecate the present invention. Of course, such a combination is impermissible, and for this reason alone, Applicant requests that the Section 103 rejection of Claims 6-7, 12-13, 20-21, and 26-27 be withdrawn.

Moreover, and to the extent understood, neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest the claimed combination, and as such, the presently pending claims are patentably distinguishable from the cited combination. Specifically, Claims 6-7 and 12-13 depend, directly or indirectly, on Claim 1 which recites a method for imaging an object with a computed tomographic (CT) imaging system, including the steps of "helically scanning the object with a multi-slice CT imaging system to acquire attenuation measurements of the object, the measurements including more than two conjugate samples; estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object".

Neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest a method for imaging an object with a CT imaging system, including the steps of helically scanning the object with a multi-slice CT imaging system to acquire attenuation measurements of the object, the measurements including more than two conjugate samples, estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples, and filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object. Moreover, neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest a method including the steps of "estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filtering and backprojecting the attenuation measurements of the object, including the more than two

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conjugate samples, to reconstruct at least one image slice of the object". Rather, Taguchi et al. describe selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means, producing desired data at the target slicing location by interpolation between the two selected data, and processing the requested data by a common fan-beam reconstruction, and Berlad describes that the most general polynomial interpolation is given by the Lagrange polynomial. For the reasons set forth above, Claim 1 is submitted to be patentable over Taguchi et al. in view of Berlad.

Claims 6-7 and 12-13 depend from independent Claim 1. When the recitations of Claims 6-7 and 12-13 are considered in combination with the recitations of Claim 1, Applicant submits that dependent Claims 6-7 and 12-13 likewise are patentable over Taguchi et al. in view of Berlad.

Claims 20-21 and 26-27 depend, directly or indirectly, on Claim 15, which recites a computed tomographic (CT) imaging system for imaging an object, the system including a radiation source and a multi-slice detector configured to acquire attenuation measurements of an object between the radiation source and the multi-slice detector, the system configured to "helical scan the object to acquire attenuation measurements of the object, said measurements including more than two conjugate samples; estimate a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object".

Neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest a CT imaging system as recited in Claim 15. Specifically, Taguchi et al. does not describe or suggest a CT imaging system configured to helical scan the object to acquire attenuation measurements of the object, the measurements including more than two conjugate samples, estimate a projection at a plane of reconstruction of the object using the attenuation

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measurements of the object, including the more than two conjugate samples, and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object. Moreover, neither Taguchi et al. nor Berlad, considered alone or in combination, describe or suggest a CT imaging system configured to "estimate a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object". Rather, Taguchi et al. describe selecting two data located on both sides of the target slicing location from groups of the real data and their opposite data sampled by the detecting means, producing desired data at the target slicing location by interpolation between the two selected data, and processing the requested data by a common fan-beam reconstruction, and Berlad describes that the most general polynomial interpolation is given by the Lagrange polynomial. For the reasons set forth above, Claim 15 is submitted to be patentable over Taguchi et al. in view of Berlad.

Claims 20-21 and 26-27 depend from independent Claim 15. When the recitations of Claims 20-21 and 26-27 are considered in combination with the recitations of Claim 15, Applicant submits that dependent Claims 20-21 and 26-27 likewise are patentable over Taguchi et al. in view of Berlad.

For the reasons set forth above, Applicant respectfully requests that the rejection of Claims 6-7, 12-13, 20-21, and 26-27 under 35 U.S.C. 103(a) be withdrawn.

Claims 8, 10, 14, 22, 24, and 28 are indicated as being allowable if amended to incorporate the recitations of the base claim and any intervening claims. Claims 8, 10, 14, 22, 24, and 28 depend, directly or indirectly, from their respective independent Claims 1 and 15, which are submitted to be in condition for allowance. When the recitations of 8, 10, 14, 22, 24, and 28 are considered in combination with the recitations of their respective independent Claims

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1 and 15, Applicant submits that dependent Claims 8, 10, 14, 22, 24, and 28 are also in condition for allowance.

In view of the foregoing remarks, this application is believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully Submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Jiang Hsieh

Art Unit: 2623

Serial No.: 09/557,108

Examiner: Chong R. Kim

Filed: April 24, 2000

For: METHODS AND APPARATUS
FOR HELICAL
RECONSTRUCTION FOR
MULTISLICE CT SCAN

SUBMISSION OF MARKED UP PARAGRAPHS AND CLAIMS

Box Non-Fee Amendment
Hon. Commissioner for Patents
Washington, D.C. 20231

Sir:

Submitted herewith are marked up paragraphs in accordance with 37 C.F.R.
1.121(b)(1)(iii), wherein additions are underlined and deletions are [bracketed].

IN THE SPECIFICATION:

Please replace the paragraph beginning on page 8, line 2, and ending on page 8, line 7,
with the following replacement paragraph.

In this notation, x_1 , x_2 , and x_3 are x-axis coordinates of locations of measured signals,
and x is the location of the signal to be estimated. The weights used in linear interpolation are
calculated based on a relative distance of the two points to the interpolation location. Combined
weights for points x_1 , x_2 , and x_3 (denoted by q_1 , q_2 , and q_3 , respectively) are written as:

$$\begin{aligned} q_1 &= \left(1 - t_2^{[a]x} - t_3^{[a]x}\right) e_1, \\ q_2 &= \left(1 - t_2^{[a]x} - t_3^{[a]x}\right) e_2 + \left(t_2^{[a]x} + t_3^{[a]x}\right) t_2, \\ q_3 &= \left(t_2^{[a]x} + t_3^{[a]x}\right) t_3. \end{aligned} \quad (7)$$

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1. (once amended) A method for imaging an object with a computed tomographic (CT) imaging system, comprising the steps of:

helically scanning the object with a multi-slice CT imaging system to acquire attenuation measurements of the object, the measurements including more than two conjugate samples [for estimation of a projection at a plane of reconstruction of the object; and];

estimating a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and

filtering and backprojecting the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object.

15. (once amended) A computed tomographic (CT) imaging system for imaging an object, said system comprising a radiation source and a multi-slice detector configured to acquire attenuation measurements of an object between said radiation source and said multi-slice detector, said system configured to:

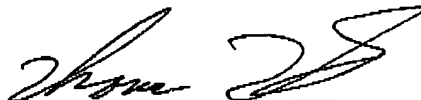
helical scan the object to acquire attenuation measurements of the object, said measurements including more than two conjugate samples [for estimation of a projection at a plane of reconstruction of the object; and];

estimate a projection at a plane of reconstruction of the object using the attenuation measurements of the object, including the more than two conjugate samples; and

filter and backproject the attenuation measurements of the object, including the more than two conjugate samples, to reconstruct at least one image slice of the object.

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